

IC ICM C30B029-06
CC 75-1 (Crystallography and Liquid Crystals)
Section cross-reference(s): 76

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2001064095	A2	20010313	JP 1999-241185	19990827
PRAI	JP 1999-241185		19990827		
AB	Claimed are Si wafers with N concn. (1 .times. 1014)-(4 .times. 1014) atoms/cm3 that are optimized for the max. effect of hydrogen annealing by which point defects are compensated.				
ST	defect recoverable nitrogen doped silicon wafer ; annealing Czochralski silicon wafer				
	defect compensation				
IT	Annealing				
	Czochralski crystal growth				
	Point defects				
	Semiconductor materials				
	(manuf. of Czochralski Si wafers with optimum N concn. for the max. annealing effects)				
IT	1333-74-0, Hydrogen, uses				
	RL: NUU (Other use, unclassified); USES (Uses)				
	(annealing atm.; manuf. of Czochralski Si wafers with optimum N concn. for the max. annealing effects)				
IT	7727-37-9, Nitrogen, uses				
	RL: MOA (Modifier or additive use); USES (Uses)				
	(manuf. of Czochralski Si wafers with optimum N concn. for the max. annealing effects)				
IT	7440-21-3, Silicon, processes				
	RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)				
	(semiconductive, N-doped; manuf. of Czochralski Si wafers with optimum N concn. for the max. annealing effects)				

L5 ANSWER 35 OF 44 CAPLUS COPYRIGHT 2003 ACS

AN 2000:694251 CAPLUS

DN 133:274477

TI **Czochralski** growth of silicon single crystal, silicon **wafer**, and estimation of nitrogen dopant concentration

IN Asayama, Eiichi; Umeno, Shigeru; Hohrai, Masataka

PA Sumitomo Metal Industries, Ltd., Japan

SO Jpn. Kokai Tokkyo Koho, 8 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM C30B029-06

ICS C30B015-00; H01L021-324; H01L021-66

CC 75-1 (Crystallography and Liquid Crystals)

Section cross-reference(s): 76

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2000272997	A2	20001003	JP 1999-83882	19990326
PRAI	JP 1999-83882		19990326		
AB	A method for growing a silicon single crystal by a Czochralski method involves doping the single crystal with N so that an OSF region .gtoreq.103 cm-2 would be formed on the overall surface of a wafer cut from the single crystal. Addnl., the wafer may have oxygen-pptn. and oxygen-pptn. prevention regions. The formation of grown-in defects is prevented. A nm for estg. the concn. of the N dopant involves detg. the d. of OSF.				
ST	Czochralski growth silicon nitrogen doping				
IT	Czochralski crystal growth				
	Dopants				
	Doping				
	Stacking faults				

L5 ANSWER 16 OF 44 CAPLUS COPYRIGHT 2003 ACS

AN 2002:241140 CAPLUS

DN 136:255640

TI Method of producing silicon **wafer**, and silicon **wafer**

IN Tamatsuka, Masaro; Qu, Wei Feig; Kobayashi, Norihiro

PA Shin-Etsu Handotai Co., Ltd., Japan

SO PCT Int. Appl., 26 pp.

CODEN: PIXXD2

DT Patent

LA Japanese

IC ICM H01L021-322

CC 76-2 (Electric Phenomena)

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	WO 2002025716	A1	20020328	WO 2001-JP8005	20010914
	W: KR, SG, US				
	RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR				
	JP 2002100632	A2	20020405	JP 2000-286068	20000920
PRAI	JP 2000-286068	A	20000920		

AB The invention relates to a method of producing a silicon **wafer** comprising the steps of growing a **nitrogen-doped silicon** single-crystal bar having a resistivity of at least 100 .OMEGA..cm and an initial interstitial oxygen concn. of 10-25 ppm-a by a **CZ** method, processing the silicon single-crystal bar into a **wafer**, and heat-treating the **wafer** to thereby reduce a residual interstitial oxygen concn. in the **wafer** to up to 8 ppm-a; and a method of producing silicon **wafer** comprising the steps of growing a **nitrogen-doped silicon** single-crystal bar having a resistivity of at least 100 .OMEGA..cm and an initial interstitial oxygen concn. of up to 8 ppm-a by a **CZ** method, processing the silicon single-crystal bar into a **wafer**, and heat-treating the **wafer** to thereby form an oxygen deposition layer on a **wafer** bulk unit; and a silicon **wafer** produced by these prodn. methods, whereby forming a high-quality DZ layer and pos. providing a DZ-IG **wafer** capable retaining a high resistivity despite a device prodn. heat treating.

ST **Czochralski** crystal growth silicon **wafer**

IT **Czochralski** crystal growth

(**Czochralski** crystal growth process for silicon **wafer**)

IT 7440-21-3, Silicon, processes

RL: EPR (Engineering process); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)

(**Czochralski** crystal growth process for silicon **wafer**)

RE.CNT 16 THERE ARE 16 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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- (4) Shin-Etsu Handotai Company Limited; JP 11322491 A 1999 CAPLUS
- (5) Shin-Etsu Handotai Company Limited; JP 2000211995 A 1999 CAPLUS
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- (7) Shin-Etsu Handotai Company Limited; EP 942078 A1 1999 CAPLUS
- (8) Shin-Etsu Handotai Company Limited; KR 99077707 A 1999
- (9) Sony Corporation; CA 1223798 A 1983 CAPLUS
- (10) Sony Corporation; GB 2109267 A 1983 CAPLUS
- (11) Sony Corporation; FR 2515216 A 1983 CAPLUS
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- (14) Sony Corporation; NL 8204133 A 1983 CAPLUS
- (15) Sony Corporation; JP 6390141 A 1988
- (16) Toshiba Corporation; JP 62202528 A 1987 CAPLUS

L5 ANSWER 27 OF 44 CAPLUS COPYRIGHT 2003 ACS
 AN 2001:531893 CAPLUS
 DN 135:114686
 TI Silicon single crystal ingot, manufacture of the ingot by
Czochralski method, and manufacture of silicon **wafer**
 IN Minami, Toshiro; Hirano, Yumiko
 PA Toshiba Ceramics Co., Ltd., Japan
 SO Jpn. Kokai Tokkyo Koho, 9 pp.
 CODEN: JKXXAF
 DT Patent
 LA Japanese
 IC ICM C30B029-06
 ICS C30B029-06; C30B015-04; H01L021-02; H01L021-208; H01L021-304
 CC 75-1 (Crystallography and Liquid Crystals)
 Section cross-reference(s): 76

FAN.CNT 2

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2001199794	A2	20010724	JP 2000-8007	20000117
	US 2001029883	A1	20011018	US 2001-760713	20010117
	US 6517632	B2	20030211		
PRAI	JP 2000-8007	A	20000117		
	JP 2000-98115	A	20000331		

AB The Si ingot is that prep'd. by the claimed **Czochralski** method using a melt made of polycryst. Si doped with 1 .times. 1013-5 .times. 1015 atom/cm3 N and 5 .times. 1015-3 .times. 1016 atom/cm3 C for obtaining the ingot with the dopant concns. similar to those in the melt. The Si **wafer** is manuf'd. by slicing the obtained ingot and (a) heating for forming crystal defects as getters or (b) polishing and etching for forming the mirror surface with .ltoreq.2/cm2 d. of .gtoreq.0.11-.mu.m etch pit and max. etch pit size .ltoreq.0.15 .mu.m. The **wafer** provides a semiconductor device showing good voltage resistance on oxide capacitor films.

ST silicon single crystal ingot **Czochralski** method;
nitrogen carbon doped silicon semiconductor
wafer; getter heating doped silicon **wafer** semiconductor;
 polishing etching doped silicon **wafer**; oxide capacitor voltage resistance semiconductor device

IT Etching
 Polishing

(**Czochralski** crystal growth for forming carbon- and
nitrogen-doped silicon followed by)

IT Getters

(**Czochralski** crystal growth for forming carbon- and
nitrogen-doped silicon followed by heating
 for forming)

IT **Czochralski** crystal growth
 Semiconductor devices

(**Czochralski** crystal growth for forming carbon- and
nitrogen-doped silicon for semiconductor
 device)

IT 7440-21-3, Silicon, properties

RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process); USES (Uses)

(**Czochralski** crystal growth for forming carbon- and
nitrogen-doped silicon for semiconductor
 device)

IT 7440-44-0, Carbon, uses 7727-37-9, Nitrogen, uses

RL: MOA (Modifier or additive use); USES (Uses)

(**Czochralski** crystal growth for forming carbon- and
nitrogen-doped silicon for semiconductor
 device)

IT 7664-41-7, Ammonia, uses 7722-84-1, Hydrogen peroxide, uses 7732-18-5,
 Water, uses

RL: NUU (Other use, unclassified); USES (Uses)

(etchant; **Czochralski** crystal growth for forming carbon- and

(**Czochralski** growth of silicon single crystal, silicon
wafer, and estn. of nitrogen dopant concn.)
IT 7727-37-9, Nitrogen, uses
RL: MOA (Modifier or additive use); USES (Uses)
(**Czochralski** growth of silicon single crystal, silicon
wafer, and estn. of nitrogen dopant concn.)
IT 7440-21-3, Silicon, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(**Czochralski** growth of silicon single crystal, silicon
wafer, and estn. of nitrogen dopant concn.)

L5 ANSWER 39 OF 44 CAPLUS COPYRIGHT 2003 ACS
AN 1999:802752 CAPLUS
DN 132:29052
TI Nitrogen-doped and low-defect silicon single crystal **wafer** and
its production by **Czochralski** method
IN Iida, Makoto; Tamazuka, Masaro; Kimura, Masaki; Muraoka, Shozo
PA Shinetsu Handotai Co., Ltd., Japan
SO Jpn. Kokai Tokkyo Koho, 11 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM C30B015-04
ICS C30B029-06; H01L021-02; H01L021-322
CC 75-1 (Crystallography and Liquid Crystals)
Section cross-reference(s): 76

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 11349394	A2	19991221	JP 1998-172274	19980604
PRAI	JP 1998-172274		19980604		

AB A **nitrogen-doped silicon** single crystal
wafer grown by a **Czochralski** method is free of
dislocation clusters although there are excess interstitial Si on the
crystal surface. A method for growing the above single crystal by a
Czochralski method is also described.

ST **nitrogen doped silicon Czochralski**
crystal growth

IT **Czochralski** crystal growth
(nitrogen-doped and low-defect silicon single crystal **wafer**
and prodn. by **Czochralski** method)

IT 7727-37-9, Nitrogen, uses
RL: MOA (Modifier or additive use); USES (Uses)
(nitrogen-doped and low-defect silicon single crystal **wafer**
and prodn. by **Czochralski** method)

IT 7440-21-3, **Silicon**, processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or
engineered material use); PROC (Process); USES (Uses)
(**nitrogen-doped** and low-defect silicon single
crystal **wafer** and prodn. by **Czochralski** method)

L5 ANSWER 42 OF 44 CAPLUS COPYRIGHT 2003 ACS
AN 1999:415999 CAPLUS
DN 131:137304
TI High-performance silicon wafers with wide grown-in void-free zone and
high-density internal gettering site achieved via rapid crystal growth
with nitrogen doping and high-temperature hydrogen and/or argon annealing
AU Tamatsuka, Masaro; Kobayashi, Norihiro; Tobe, Satoshi; Masui, Tumoru
CS Material Science Department of SEH Isobe R&D Center, Shin-Etsu Handotai
Co., Ltd., Annaka, 379-0199, Japan
SO Proceedings - Electrochemical Society (1999), 99-1(Defects in Silicon),
456-467
CODEN: PESODO; ISSN: 0161-6374
PB Electrochemical Society
DT Journal
LA English

CC 76-3 (Electric Phenomena)

AB Grown-in voids annihilation phenomena due to high temp. hydrogen and argon annealing have been investigated for a **nitrogen-doped Czochralski silicon** substrate. Grown-in voids can be annihilated up to 2-10 .mu.m depending on the initial oxygen concn. in the nitrogen-doped substrate, while they can still exist at 0-2 .mu.m depth in a non-nitrogen-doped substrate. This annihilation efficiency strongly depends on the initial void size and oxygen concn. The combination of rapid growth and nitrogen doping is best to achieve smaller voids so as to deepen the void-free zone. In addn., in the same growth rate crystal, the lower the initial oxygen concn. the deeper the void-free zone. A model based on point-defect injection and out-diffusion is proposed to explain the dependence of void annihilation depth on initial oxygen concn. and void size. The simulation results are quant. consistent with the exptl. results. This is the first report revealing the dependence of grown-in void annihilation depth on the oxygen concn. in a **nitrogen-doped Czochralski silicon** substrate.

ST **Czochralski crystal growth silicon wafer**; void free zone **Czochralski silicon wafer**; gettering **Czochralski silicon wafer**

IT **Czochralski crystal growth**
Gettering
(high-performance Si wafers with high-d. internal gettering site achieved via rapid crystal growth and high-temp. annealing)

IT 7440-21-3, Silicon, properties
RL: FMU (Formation, unclassified); PEP (Physical, engineering or chemical process); PRP (Properties); FORM (Formation, nonpreparative); PROC (Process)
(wafers; high-performance silicon wafers with wide grown-in void-free zone achieved via rapid crystal growth and high-temp. annealing)

RE.CNT 28 THERE ARE 28 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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- (2) Abe, T; The Electrochemical Society Spftbound Proceeding Series 1998, PV98-1, P157
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- (26) Vanhellemont, J; J Appl Phys 1987, V62, P3960 CAPLUS
- (27) Yamagishi, H; Semicond Sci Technol 1992, V7, PA135 CAPLUS
- (28) Zhong, L; J Appl Phys 1993, V73, P707 CAPLUS

nitrogen-doped silicon followed by etching)

L5 ANSWER 33 OF 44 CAPLUS COPYRIGHT 2003 ACS
AN 2001:270378 CAPLUS
DN 134:288183

TI Epitaxy on defect-minimized and **nitrogen-doped**

Czochralski silicon wafers

IN Asayama, Eiichi; Umeno, Shigeru; Horai, Masataka
PA Sumitomo Metal Industries, Ltd., Japan

SO Jpn. Kokai Tokkyo Koho, 8 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM C30B029-06

ICS C30B025-02

CC 75-1 (Crystallography and Liquid Crystals)

Section cross-reference(s): 76

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2001106594	A2	20010417	JP 1999-286586	19991007
	US 6365461	B1	20020402	US 2000-679888	20001005
PRAI	JP 1999-286586	A	19991007		

AB The epitaxy is carried out on N-doped Si single-crystal wafers with O concn. .ltoreq.9 .times. 10¹⁷ atoms/cm³ in O-induced stacking fault (OSF) ring regions. The wafers may be sliced out from N-doped

Czochralski ingots where the OSF rings appear .gtoreq.85% (from the center) radius position. The ingots may be doped with (1 .times. 10¹²) - (1 .times. 10¹⁴)-atoms/cm³ N and may be withdrawn at .gtoreq.1.2 mm/min. The as-sliced wafers may be annealed at 1200-1300.degree. for .gtoreq.1 min. The process minimizes dislocations or stacking faults in the epi layers without decreasing O ppts. which work as impurity getters.

ST silicon epitaxy dislocation fault minimized; **nitrogen doped silicon wafer** epitaxy; OSF location controlled silicon **wafer** epitaxy; annealed silicon **wafer** epitaxy

IT Stacking faults

(O-induced; epitaxy on defect-minimized and N-doped Si wafers with minimized OSF concn.)

IT Annealing

Czochralski crystal growth

Epitaxy

Semiconductor materials

(epitaxy on defect-minimized and N-doped Si wafers with minimized OSF concn.)

IT 7440-21-3, Silicon, processes

RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)

(N-doped; epitaxy on defect-minimized and N-doped Si wafers with minimized OSF concn.)

IT 7727-37-9, Nitrogen, processes 7782-44-7, Oxygen, processes

RL: MOA (Modifier or additive use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)

(epitaxy on defect-minimized and N-doped Si wafers with minimized OSF concn.)

L5 ANSWER 34 OF 44 CAPLUS COPYRIGHT 2003 ACS

AN 2001:174027 CAPLUS

DN 134:215172

TI Manufacture of **nitrogen-doped Czochralski**

silicon wafers containing size-reduced point defects

IN Komiya, Satoshi; Yoshino, Shiro; Danbata, Masayoshi; Hayashida, Koichiro

PA Komatsu Denshi Kinzoku K. K., Japan

SO Jpn. Kokai Tokkyo Koho, 6 pp.

CODEN: JKXXAF

DT Patent

LA Japanese